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Test Results on a 1975 California Vega Equipped with the Gould Dual-Catalyst Emission Control System

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Technology Assessment and Evaluation Branch
Emission Control Technology Division
Office of Mobile Source Air Pollution Control
Environmental Protection Agency

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16. ABSTRACT

The Gould Corporation, New Business Division of Cleveland, Ohio requested confirmatory testing of a 1975 California Vega equipped with their catalyst system. The Emission Control Technology Division of the Environmental Protection Agency agreed to test the vehicle on May 6, 1975.

The EPA receives information about many devices for which emission reduction or fuel economy improvement claims are made. In some cases, both claims are made for a single device. The EPA is interested in evaluating the validity of the claims for all such devices, because of the obvious benefits to the Nation of identifying devices that live up to their claims. For that reason the EPA invites proponents of such devices to provide to the EPA complete technical data on the device's principle of operation, together with test data on the device made by independent laboratories. In those cases in which review by EPA technical staff suggests that the data submitted holds promise of confirming the claims made for the device, confirmatory tests are scheduled at the EPA Emissions Laboratory. The results of all such confirmatory test projects are set forth in a series of Technology Assessment and Evaluation Reports, of which this report is one.

17. KEY WORDS AND DOCUMENT ANALYSIS

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Background

The Gould Corporation, New Business Division of Cleveland, Ohio requested confirmatory testing of a 1975 California Vega equipped with their catalyst system. As part of a continuing program for the evaluation of new developments in emission control, the Emission Control Technology Division agreed to test the vehicle. Arrangements were made with Mr. Richard Steiner of Gould, to test the vehicle on May 6, 1975.

The Environmental Protection Agency receives information about many devices for which emission reduction or fuel economy improvement claims are made. In some cases, both claims are made for a single device. In most cases, these devices are being recommended or promoted for retrofit to existing vehicles although some represent advanced systems for meeting future standards.

The EPA is interested in evaluating the validity of the claims for all such devices, because of the obvious benefits to the Nation of identifying devices that live up to their claims. For that reason the EPA invites proponents of such devices to provide to the EPA complete technical data on the device's principle of operation, together with test data on the device made by independent laboratories. In those cases in which review by EPA technical staff suggests that the data submitted holds promise of confirming the claims made for the device, confirmatory tests of the device are scheduled at the EPA Emissions Laboratory at Ann Arbor, Michigan. The results of all such confirmatory test projects are set forth in a series of Technology Assessment and Evaluation Reports, of which this report is one.

The conclusions drawn from the EPA confirmatory tests are necessarily of limited applicability. A complete evaluation of the effectiveness of an emission control system in achieving its claimed performance improvements on the many different types of vehicles that are in actual use requires a much larger sample of test vehicles than is economically feasible in the confirmatory test projects conducted by EPA. 1/ For promising devices it is necessary that more extensive test programs be carried out.

The conclusions from the EPA confirmatory tests can be considered to be quantitatively valid only for the specific type of vehicle used in the EPA confirmatory test program. Although it is reasonable to

1/ See Federal Register 38 FR 11334, 3/27/74, for a description of the test protocols proposed for definitive evaluations of the effectiveness of retrofit devices.

extrapolate the results from the EPA confirmatory test to other types of vehicles in a directional or qualitative manner, i.e., to suggest that similar results are likely to be achieved on other types of vehicles, tests of the device on such other vehicles would be required to reliably quantify results on other types of vehicles.

In summary, a device that lives up to its claims in the EPA confirmatory test must be further tested according to protocols described in footnote 1/, to quantify its beneficial effects on a broad range of vehicles. A device which when tested by EPA does not meet the claimed results would not appear to be a worthwhile candidate for such further testing from the standpoint of the likelihood of ultimately validating the claims made. However, a definitive quantitative evaluation of its effectiveness on a broad range of vehicle types would equally require further tests in accordance with footnote 1/.

System Description

The test vehicle was a 1975 Vega Notchback (2 door sedan) produced in compliance with the 1975 California vehicle emissions standards. See Table I for vehicle description. The vehicle as tested had an odometer reading of 6,610 miles. The modifications had been made shortly before our tests, thus the system tested was a "zero mile" modification to a "stabilized" vehicle.

Exhaust emissions were controlled by a Gould Getter catalyst system employing three catalyst beds. (See Figures 1 and 2). The first bed, a small Engelhard PTX-IIB catalyst, removed oxygen and provided early cold start-up hydrocarbon and carbon monoxide oxidation. The second bed, a Gould Gem 68 catalyst, reduced nitrogen oxides. After the second bed, secondary air was injected into the exhaust gas to provide sufficient oxygen for oxidation of the remaining hydrocarbons and carbon monoxide in the third bed, an Engelhard PTX-IIB monolith. Air injection after the Gem catalyst was continuous, while air injection to the exhaust ports was limited to 60 seconds during cold starts. The standard exhaust gas recirculation (EGR) was not changed. Ignition timing at idle was increased from 12° BTDC to 18° BTDC. An anti-stall device was installed to override the thermal check and delay valve which normally shuts off vacuum advance during cold starts. The anti-stall override was activated when a stall was determined to be iminent by sensing manifold vacuum. Carburetor adjustments made are listed in Table II. These adjustments, though minor, provided leaner carburetion. The evaporative emission canister was disconnected.

Table I

Test Vehicle Description

Chassis model year/make - 1975 Chevrolet Vega Notchback

Engine

type	4 stroke Otto cycle, Overhead cam, in-line 4 cyl.
bore x stroke	3.50 x 3.63 in/88.9 x 92.2 mm
displacement	140 CID/2,294 cc
compression ratio	7.9:1
maximum power @ rpm	80 hp/60 kW @ 4400 rpm
fuel metering	2-V carburetor

Drive Train

transmission type	3 speed automatic
final drive ratio	2.92:1

Chassis

type	unitized construction, front engine, rear wheel drive
tire size	BR 78-13
curb weight	2540 lb/1152 kg
inertia weight	2750 lb/1247 kg
passenger capacity	4

Emission Control System

basic type	reduction catalyst (GEM 68), oxidation catalyst (Engelhard PTX-IIB), air injection exhaust gas recirculation, positive crankcase ventilation

FIGURE 1

GOULD GETTER SYSTEM

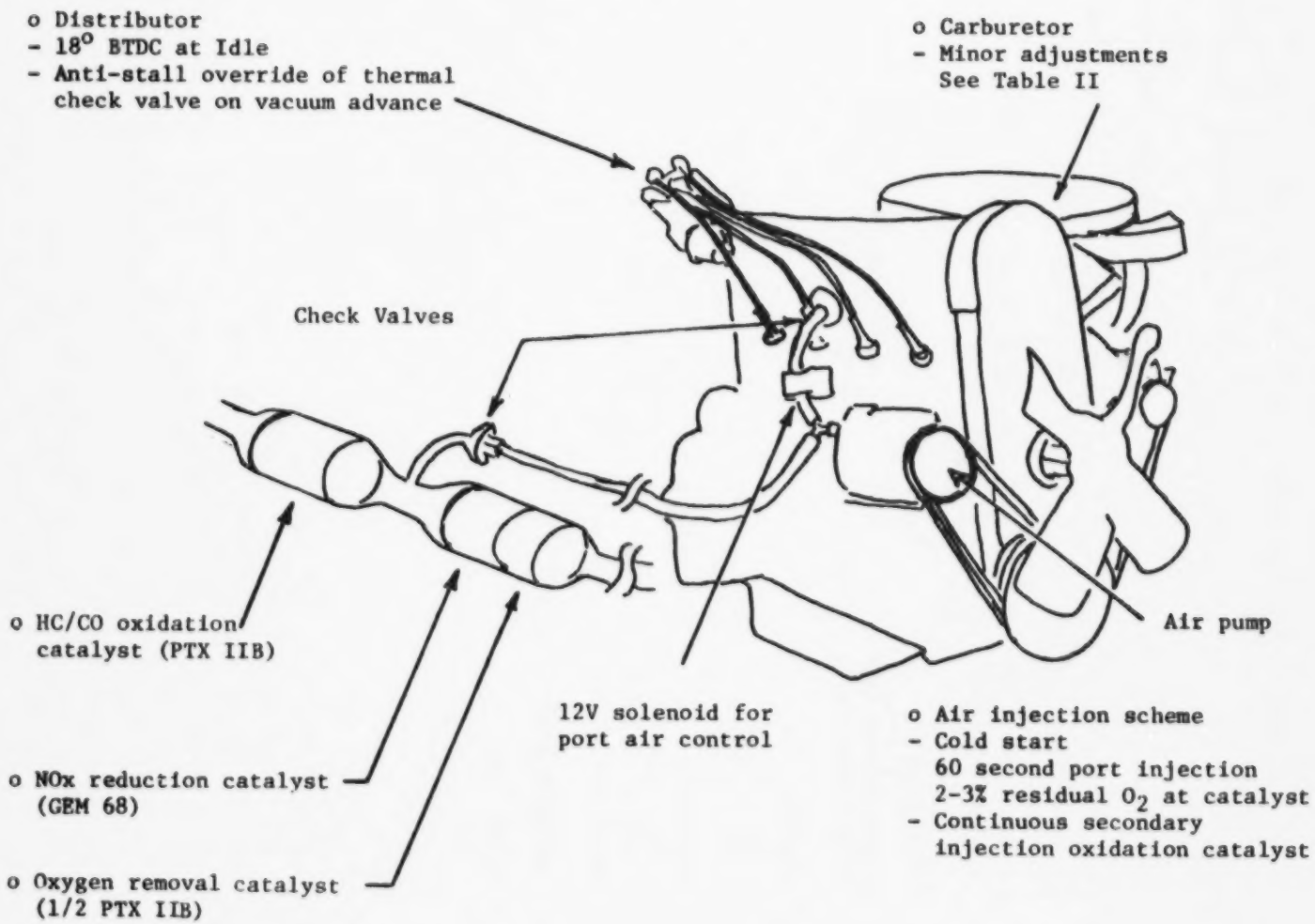
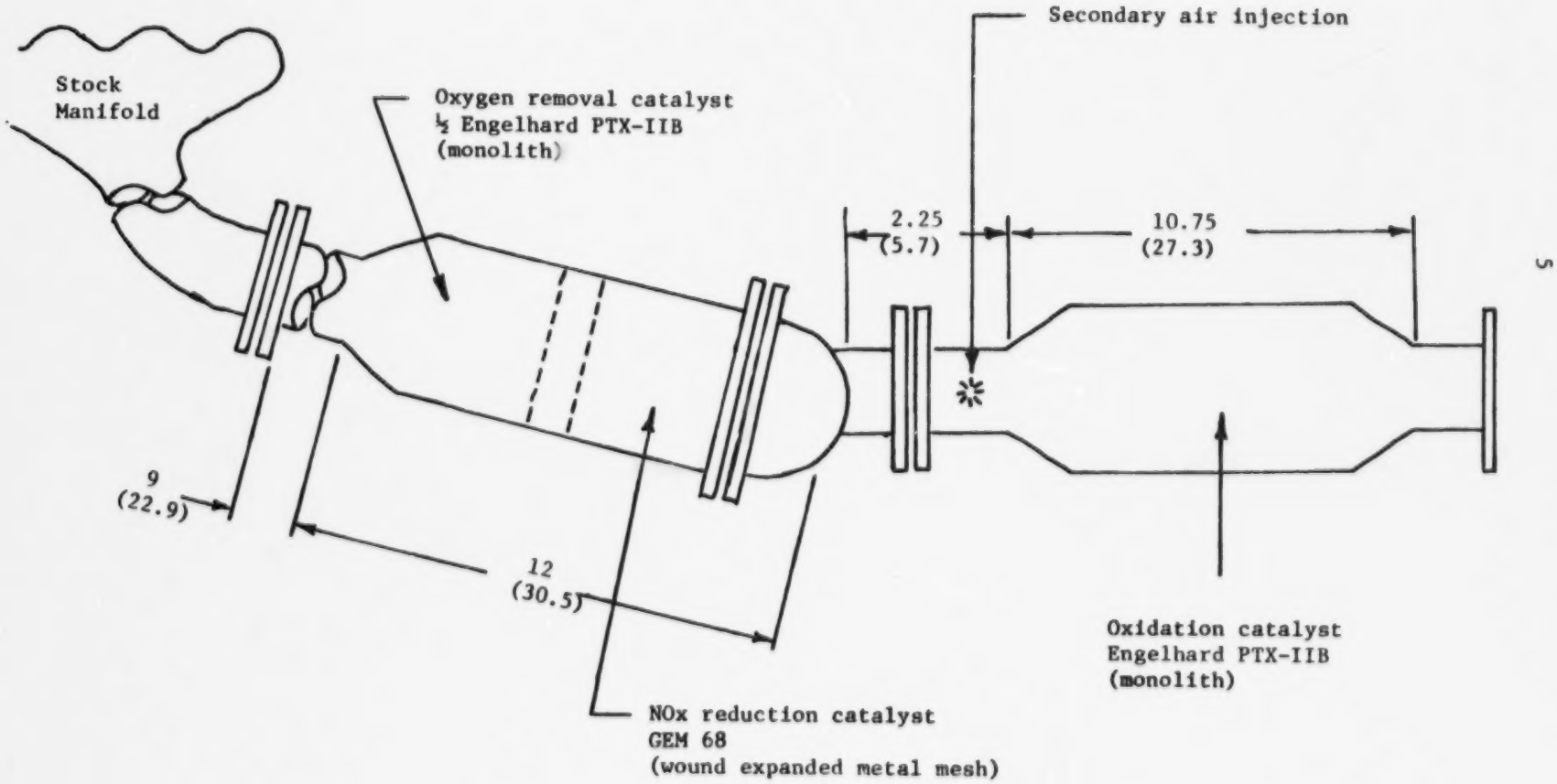

o Distributor
- 18° BTDC at Idle
- Anti-stall override of thermal check valve on vacuum advance
o Carburetor
- Minor adjustments
See Table II
Check Valves
o HC/CO oxidation catalyst (PTX IIB)
Air pump
12V solenoid for port air control
o Air injection scheme
- Cold start
60 second port injection
2-3% residual O_2 at catalyst
- Continuous secondary injection oxidation catalyst
o NOx reduction catalyst (GEM 68)
o Oxygen removal catalyst (1/2 PTX IIB)

FIGURE 2

GOULD CATALYST SYSTEM
DIMENSIONS IN INCHES
(centimeters)



Test Procedures and Results

The testing consisted of one 1975 Federal Test Procedure ('75 FTP) described in the Federal Register of November 15, 1972; and one EPA Highway Cycle (HWC), described in the EPA Recommended Practices for Conducting Highway Fuel Economy Tests. Both of these tests are conducted on a chassis dynamometer and employ the Constant Volume Sampling (CVS) procedure, which gives exhaust emissions of HC, CO, NOx and CO_2 in grams per mile. Fuel economy is calculated by the carbon balance method. The fuel used was Indolene unleaded 96 RON gasoline.

The results of these tests are shown in Tables III, IV and V.

Conclusions

The hydrocarbon and carbon monoxide emissions on the '75 FTP from this "zero mile" system were well within the statutory 1978 standards of 0.41 grams per mile and 3.4 grams per mile respectively. The NOx emissions of .42 slightly exceeded the statutory '78 standard of 0.4 grams per mile. The ability of this system to approach the statutory '78 standards and still maintain or slightly improve upon the fuel economy of the 1975 Vega is promising. This coupled with the relative simplicity of the system and its compatibility with existing control hardware and calibrations make it an attractive emission control package. As this was a "zero mile" test the durability of the system and its ability to maintain emission levels with mileage accumulation have yet to be demonstrated.

Table II

Carburetor Adjustments

	Stock	Gould NOx System
Primary main jet	0.0535"	0.0530"
Primary air bleed	0.065"	0.072"
Carburetor idle (D)	750 rpm	800 rpm
Choke index	4-rich	1-lean
Choke pulldown	0.186"	0.260"
Choke delay restriction	Stock	removed
Cold idle speed (N)	1600 rpm	1800 rpm

Table III

Gould Vega '75 FTP Individual Bag and
EPA Highway Cycle Mass Emissions
grams per mile
(grams per kilometre)

Test Cycle	HC	CO	CO_2	NOx	Fuel Economy (Fuel Consumption)
'75 FTP Cold Transient	0.52 (0.32)	3.27 (2.03)	499 (310)	0.59 (0.37)	17.5 miles/gal (13.4 litres/100 Km)
'75 FTP Cold Stabilized	0.19 (0.12)	0.02 (0.01)	451 (280)	0.33 (0.21)	19.7 miles/gal (11.9 litres/100 Km)
'75 FTP Hot Transient	0.19 (0.12)	0.08 (0.05)	408 (253)	0.46 (0.29)	21.7 miles/gal (10.8 litres/100 gal
EPA Highway	0.11 (0.07)	0.03 (0.02)	306 (190)	0.29 (0.18)	29.0 miles/gal (8.11 litres/100 gal

Table IV

'75 FTP Composite Mass Emissions
grams per mile
(grams per kilometre)

	HC	CO	CO_2	NOx
Gould Vega	0.26 (0.16)	0.71 (0.44)	449 (279)	0.42 (0.26)
1975 Calif. Standard	0.9 (0.56)	9.0 (5.6)		2.0 (1.24)
1978 Federal Statutory Standard	0.41 (0.25)	3.4 (2.1)		0.4 (0.25)

Table V

'75 FTP (City) and HWC (Highway) Fuel Economies/Fuel Consumption
miles per gallon
(litres per 100 kilometres)

	City	Highway
Gould Vega	19.7 (11.9)	29.0 (8.1)
EPA Certification Vega*	19 (12.4)	28 (8.4)

* As published in the 1975 EPA Gas Mileage Guide for New Car Buyers in California.